The DRILLER

6-8-11

3 *"Watch Our Smoke"* . . .

Could well be the words of these Hickory Pump Co., N. C., drillers who were down 108 feet with their hole when snapped beside the 21-W.

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VOLUME 20 JULY, 1946 NUMBER 7

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Development By Chemical

by

T. E. LARSON AND H. E. ROMINE

CHEMICAL treatment as a method of water well development or rehabilitation has been used for more than 30 years. When applied correctly and at the proper place it is reasonable to expect this type of treatment to successfully increase the yield of a well by improving the hydraulic flow characteristics of the well.

Chemical treatment has proven to be unsatisfactory in several cases and as a result has received a black eye where it has not always been justified. Before chemical treatment is applied to any well it is appropriate to attempt to determine the real reason for production decline and then decide whether chemical treatment would or would not be effective.

• Well No. 11 on the campus of the University of Illinois is shown being surged by Hayes & Sims of Champaign after being treated with acid.

Usually a brief, but comprehensive, pump efficiency and well production test is not only desirable but necessary to determine the correct procedure for subsequent work.

Before discussing chemical treatment of wells it is desirable to list some four or five reasons why a well may fail to deliver an adequate quantity of water with the passage of time.

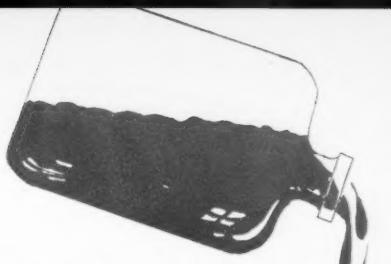
Reasons For Failure

First, there may be an insufficient quantity of water available to the well itself. This may be due to a limited original supply, and the depletion may be accelerated by the prevalence of a season of low rainfall. The well may be "dry" (loss in static head) due to over-pumpage, that is, the rate of extraction may have greatly exceeded the rate of recharge to the formation from which the water was obtained. Loss of head may be remedied only by lowering the pump or reducing pumpage. The well may have filled up or bridged over, thereby shutting off the sources of water within the well.

A second reason for failure may not be the fault of the well at all but may actually be attributed to well pump deficiency. This failure may be the result of loss in efficiency, due to normal wear of the pump itself or due to corrosive damage to the pump resulting in a hole in the column pipe or in the pump bowls or cylinder. Chemical treatment, of course, could not rectify such a situation.

Loss in pump efficiency may be the result of the formation of an

f Water Wells
eactions



iron or slime deposit clogging the effective working part of the pump. In such case acid treatment can be used effectively to clean the pump without going to the time and expense of removing and disassembling. Acid in such case should be inhibited to prevent action on the pump itself and should contain a compound to keep any iron in solution as much as possible and thereby prevent its deposition in the water producing zone of the well.

If the presence of deposits within the pump are not recognized there is no way of knowing whether subsequent treatment was such as to treat the pump or to treat the well or whether the best type and method of treatment had been applied.

A third type of failure is due to the movement of silt, clay or fine sand into the formation adjacent to the well screen in the case of drift wells or is due to the presence of clay or silt clogging the crevices which feed the water to the well in the case of limestone wells. Either of these failures could be due to over-pumpage. Pumping at excessive rates can create a sufficiently high velocity in the formation to actually move the fine sand or silt or clay close to the well behind the screen or gravel pack. This gradual accumulation effectively blocks the ready entrance of water to the well.

In the case of sand and gravel wells the solution of this problem largely depends on the driller's ingenuity. The well may possibly be re-developed by surging or by pulling the screen and bailing it back in and then re-developing the well.

In the case of limestone wells there is a good possibility that the use of acid will clean the clogged crevices, particularly if applied under pressure to keep the acid moving within the formation and forcing any clay or silt deposits out of the crevices, as they are enlarged by solution, and into the larger openings. This also allows some, if not all, of the suspended clay and silt to be removed by subsequent pumping.

A fourth type of failure may be due to the formation of chemical or bacterial deposits in the voids which normally permit entrance of water. When hard water is subjected to an appreciable drop in pressure it results in the release of carbon dioxide gas in small quantities from the water. Such release of gas automatically precipitates an *accumulative* lime (calcium carbonate) deposit at the point where the drop in pressure occurs. The drop in pressure generally occurs through an under-designed well screen with insufficient slot area, or by over-pumping a properly designed screen. This pressure drop through a screen cannot be elimi-

The authors, both of the Illinois State Water Survey Division, have prepared this manuscript for readers of THE DRILLER with the intention of giving a general picture of the use of chemicals in water well development.

• This photo shows acid and reaction products being removed from a 114-foot well at the Illinois Normal Soldiers and Sailors Home after the well had been treated with 500 gallons of 15% acid solution (note the foaming).

nated but the effect can be minimized by good construction and operating practice.

An iron oxide deposit can occur with or without the aid of bacteria on the inside of the well screen when the pumping level is below the top of the screen. This deposit gradually covers more and more of the slot area and may even extend back into the upper part of the sand and gravel in the de-watered (during pumping) part of the formation. The action of air (oxygen) at the surface of the water is responsible for the oxidation and precipitation of this iron deposit.

Bacterial growths can, and do, take place within wells, particularly where there is food present for them on which to live. Waters containing ammonia, methane, sulfates, hydrogen sulfide, manganese or ferrous iron provide suitable food for bacterial accumulation. This autotrophic bacterial growth is most active at points where air comes in contact with the surface of the water. Chlorine, acid and even salt each have a specific tendency to loosen such slime and assist in removal by surging and subsequent pumping.

Failures due to combinations of these conditions are not unusual.

When chemical treatment is in order, such chemicals may be applied through the pump in sufficient amount to at least fill the hole, and it is usually desirable to add water to help flush the chemical out into the surrounding formation. If there is a concrete plug at the bottom of the well screen, care should be taken to prevent direct delivery of the acid to the bottom of the well, since impingement of the acid on concrete dissolves it readily.

If hydrochloric acid is used, it is generally in a concentration of 15 per cent, by weight, or occasionally stronger. Such treatment should always include the addition of a non-toxic inhibitor—an agent added to the acid to prevent drastic action of the acid on the well casing and pump. Inhibitors should reduce the corrosive effect of the acid on the metals by 90 to 98 per cent. Non-toxic inhibitors are specified since toxic inhibitors are a definite health hazard. Secondary reactions in chemical treatment may necessitate weeks of pumping to remove all of the added chemicals.

Iron May Be Present

If iron is present it is also highly desirable to add a so-called "weak" acid with the hydrochloric acid for the purpose of preventing the re-deposition of iron. This "weak" acid is strong enough to keep iron in solution but it is weaker than hydrochloric acid in that it does not attack limestone or dolomite rapidly. This means that as the hydrochloric acid becomes spent the "weak" acid remains active and keeps the iron in

solution. Hydrochloric acid itself acts very rapidly to spend itself in dissolving limestone or dolomite, particularly if kept in motion. There are various "weak" acids available, each for specific conditions of treatment.

With this combination of acids, the mixture can be forced back into the formation and is effective in a short time. Without the weak acid, iron will dissolve and then again come out of solution and clog the formation before it can be pumped out. It is, therefore, desirable to remove the waste products from the well as rapidly as possible after the addition so that the weak acid is not spent before being removed. The retention time within a drift (sand and gravel) well should not exceed one hour. A period of 30 minutes or less is much more desirable. Data is not available at the present but when available they may prove that a 5 minute retention period would be entirely sufficient.

Gas Is Formed

Another effect of acid treatment is the formation of large volumes of gas in the formation. If the acid and gas are kept in motion there should be less tendency for the gas to accumulate in pockets and "gas lock" the water producing formation. "Gas locking" reduces the effective porous area which permits water to enter the well.

From a strictly chemical standpoint, all of the 15 per cent acid which comes in contact with limestone or dolomite should first produce calcium and magnesium chloride, and carbonic acid. With additional time of contact and turbulence, further reaction produces calcium and magnesium chloride and calcium and magnesium bicarbonate. By the first reaction, 368 lbs. of dolomite (calculated as $CaCO_3$) is dissolved as a minimum with the release of 161 lbs. of carbon dioxide as a maximum. With the second reaction, a total maximum of 736 lbs. of dolomite (as $CaCO_3$) is dissolved with no carbon dioxide gas. In actuality, the dolomite dissolved is between 368 and 736 lbs. or approximately 2 to 4 cu. ft. per 100 gallons of 15 per cent acid and the carbon dioxide gas produced is considerably less than 161 lbs. (1300 cubic feet at atmospheric pressure).

On occasion the addition of acid to a well liberates appreciable quantities of hydrogen sulfide gas. This gas is highly toxic when breathed in even low concentrations. The toxicity is comparable to that of hydrogen cyanide.

The addition of acid to wells may also liberate methane gas as well as carbon dioxide. The pumphouse in the immediate vicinity of the well should be kept thoroughly ventilated to prevent suffocation from high concentrations of either carbon dioxide or methane gas and to prevent the accumulation of the highly explosive methane gas. This latter gas is colorless, odorless and tasteless. It is inflammable and explosive on ignition

(Continued on page 16)

• A snap of the fleet of trucks that supplied 3000 gallons of 15 per cent hydrochloric acid solution to University of Illinois wells Nos. 10 and 11.

"Jet Rigger" PRODUCES WATER IN UTAH

• Larson stands by a flowing well he drilled for a meat packing company in Salt Lake City, Utah.

by L. H. HOUCK

THERE are a few places in the country where you can drive a pointed pipe into the ground, screw on a pitcher pump, and have a well.

It will probably be of interest to the great majority of hard-rock drillers to know of a man who has spent 45 years as a jet driller in a country where it is possible to spend a lifetime drilling both shallow and deep wells with a water jet.

Using jet rigs he built himself, V. P. Larson for 45 years has drilled water wells for airports, farms, homes, truck gardens, ice plants, meat packing plants, and many other industries in the Salt Lake City area of Utah.

Most of that time he has been a regular reader of THE DRILLER and has moments when he longs for a cable tool outfit on a new truck so he can go "up on the bench" and drill hard-rock wells along the rocky trails followed by Brigham Young and the Mormon pioneers into the Valley of the Great Salt Lake.

Mr. Larson maintains his home and office at 2547 S. State Street, Salt Lake City, Utah and has two steam operated water jet drills which he built himself.

Most drillers know the jetting principle as a matter of course. Construction men also use the jet method in digging holes for piers and other work when the ground is suitable.

Well drilling by the jet method consists of a steam boiler and a steam operated water pump. The drill bit is a perforated point which comes in

Using hand-made jet drilling rigs that he constructed himself, V. P. Larson has worked industriously for 45 years to bring life-giving water to the arid Valley of the Great Salt Lake.

various sizes and which is attached to the drilling end of the jet hose. This hose is connected to the water side of the pump and the spray of water at about 65 pounds pressure from the point digs the well. As the well progresses casing is screwed on to the point and when the well is finished, the perforated point is at the bottom and the well is cased.

Jet drilling can only be used when the ground is gravel, sand and clay, or where layers of rock formation are thin and may be dynamited through to other strata of clay, sand and gravel.

That about explains the formations in the Salt Lake Valley. Out of the valley or as the old-timers say, "up on the bench," it takes hard-rock men and hard-rock rigs.

Gets Flowing Wells

There are a great many flowing wells in this area. Larson drilled a well 920 feet deep, using a 4-inch hole, which flowed 200 gpm. and had a water of 11 grains hardness.

Larson drills a lot of wells in Salt Lake City and brought in a nice flowing well at 25 feet on East Seventh street. Two blocks away on East Fifth street another customer wanted a flowing well, particularly since the water was just 25 feet away. Larson set up this rig and hauled in some coal.

For ten days his steam pump huffed and puffed, the coal smoke skittered up streets and alleys, and the quitting whistle tooted for supper—and no water, flowing or otherwise. At around 250 feet water was encountered, but not under pressure. It was in ample quantity and rose a few feet in casing.

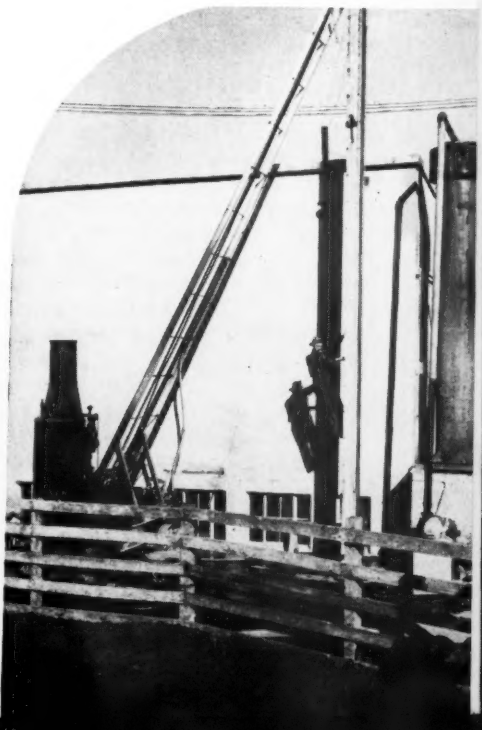
The flowing well at 25 feet only two blocks away proved the vagaries of this element so essential to human life.

Larson's deepest well was one drilled to a depth of 1020 feet in the Old Lake Bonneville district. Here drilling was easy. If it wasn't mentioned before, the point is driven into the ground by a sort of pile driver arrangement in which a weight sliding in the mast drives as the jet works. As each section is driven down a new section of pipe is screwed on.

Another well he drilled in the city was 40 feet deep and he used a 2½-inch casing. This well flowed 75 gmp. in the summer time but in the winter time ceased to flow entirely.

Larson has just finished drilling some more wells for a packing plant in Salt Lake City. Here he did not even have to bring his own coal. The packing plant had a large steam plant so Larson ran a steam line from his rig to their plant and was saved the trouble of keeping up steam.

(Continued on page 14)



• While climbing up the mast of his steam jet drill rig, Larson pauses a momen to survey the situation.

The DRILLER

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Manual Gives Tips For Aiding Sales

SEVERAL helpful tips on methods for selling water systems which drillers should find interesting appear in Chapter 16 of the "Manual of Water Supply Equipment" compiled and published by the National Association of Domestic and Farm Pumping Equipment and Allied Products Manufacturers (announcement of the manual appeared in THE DRILLER, June, 1946, page 15).

In considering the large potential market, the book points out that with expanded rural electrification a great many farmers will desire to install modern systems in their homes. Also, the non-farm homes located beyond the city water mains offer large potential sales. These home owners want every convenience that is provided by water under pressure.

Another fertile field, the manual indicates, is offered by the numerous resorts, cottages, and summer homes where the owners, visitors, and tourists will want up-to-date water conveniences. There are also many water systems now in use that are outmoded and there is a good chance of replacing these with new systems.

An important observation made concerning the sale of a new water system to a buyer is as follows: "From the day (of the purchase) on he becomes your customer for a water heater, water softener, washing machine, milking and dairy equipment, bath, kitchen, and laundry facilities, stock watering devices, air conditioning equipment and countless water-using items that follow always the water system installation."

Power Companies Help

Compilers of the book feel that one of the most effective methods of finding prospects is to work through power company offices. All power companies are interested in developing customers and users of power, and they know that the sale of a water system will open the door for electric water-using equipment. By securing from them a list of their electric customers who do not have water systems, a driller has in his possession a valuable source of potential customers.

County and home demonstration agents who are very much interested in getting more production from farms in their area recognize the importance of water and modern water systems, and they, too, can be of as-

sistance in locating customers, the manual suggests.

Another suggestion is that drillers take advantage of state and county fairs, as well as agricultural exhibits to show latest water equipment. Of the hundreds of people who will view the display, many will be in the immediate market for such equipment and it is entirely possible that some sales will be completed on the grounds, the authors indicate.

Vet Farmers Aided

VETERAN-FARMERS account for 85 per cent of the 200,000 claimants drawing self-employment allowances under the Servicemen's Readjustment Act, (G.I. Bill), a Veterans Administration survey revealed.

Allowances are available to veterans engaged in independent enterprises for profit, if net earnings for a given month are less than $100. VA pays the difference between net earnings for the month and $100. Total amount depends upon length of military service, with a maximum of 10 and two-fifths months if the veteran has had over nine and one-half months of active duty.

The bulk of farm claims come from the cotton belt states, but claims from mid-western wheat states are increasing substantially in volume.

Stolte Elevated

ANNOUNCEMENT has been made by Colonel Robert H. Morse, President and General Manager of Fairbanks, Morse & Co., that L. W. Stolte has been elected to the position of Secretary of the company, to replace Fred C. Dierks, recently returned after a long service of 45 years.

Pump Handle Pete Says:

Squirrels aint so Squirrley . . .

Maw an' me was sittin' on the stoop watchin' a squirrel yestiddy. Purty smart critter, too. Ferinstance—stores up stuff over the winter which is more'n a lot of folks do.

My JENSEN Pumping Unit is kind of a storehouse fer when the creek runs dry. It's dependable an' costs only a few cents a day to run—handles any well 100 feet or deeper, too.

See your JENSEN DEALER today or send his name and address so's you can fix up your water sitiation . . .

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NEWS OF THE MONTH

Michigan Drillers Choose Riegler And Raymer As Heads

THE 18th annual Michigan Well Drillers Association Convention held in Lansing at the Hotel Olds on June 14 and 15 broke all previous attendance records for the organization which saw the heavy registration culminate with 250 drillers and guests being present for the Banquet on Saturday evening.

The morning was spent in getting acquainted and was featured by the presentation of souvenirs to the drillers and manufacturers' representatives.

Kinsey Calls Session to Order

President C. W. Kinsey called the afternoon session to order and a general discussion was held after the introduction of the jobbers and manufacturers was completed. Entertainment that evening was furnished by R. O'Dell who presented movies accompanied by explanatory talks concerning the natives of the Pacific isles. This was followed by a buffet luncheon sponsored by the association.

The morning session on Saturday was highlighted by the election of officers for the coming year. Leo Riegler of Muskegon was selected to replace Kinsey, Saginaw, as President, and C. S. Raymer, Grand Rapids, replaced Dorr Russell, Flint, as First Vice-President. Other officers for the coming year are: Second Vice-President, Arthur Webber, Byron Center; J. C. Newman, Kalamazoo, Director; Ralph Purchase, Grandville, Director; Dorr Russell, Flint, Director; and Harold Armstrong, Battle Creek, was returned as Secretary.

Following the election, R. A. Smith, State Geologist, gave a talk picturing the present condition of water tables in respect to surface runoff and recharge in Michigan.

At the conclusion of the noon luncheon, which was also well attended, G. E. Eddy, Geological Division, Department of Conservation, enumerated 15 points which he advocated to be enacted into law in the formation of a state well code. Concluding the convention on a high note was the banquet which surpassed all expectations in attendance. The introduction of the new officers for the coming year and the floor show were high points of the evening.

E. A. O'Brien

1884-1946

Water well drillers of the Midwest were saddened to learn of the death of Edward A. O'Brien, Elgin, Illinois, who passed away May 5 at St. Joseph's hospital of that city.

Mr. O'Brien was well known and respected in his area and had been engaged in the water well contracting business since the 1920's. During his drilling experience he made a great many friends with his kind advice in connection with the water well industry.

One of the two sons surviving him, Edward, Jr., is carrying on in his father's footsteps and is continuing in the contracting practice.

Manager Appointed By Florida Firm

WILLIAM E. LEMKE has been appointed by Dave Gordon & Co., Tampa, Florida, as manager of the department providing specialized service and equipment for pumping and irrigation according to a recent news letter.

Lemke will be assisted in his department by J. A. McLaughlin who will continue in his capacity in charge of field work. A graduate engineer, Northwestern University, 1936, Lemke was manager of the Pump Department at Saunders & Co., Chicago, for six years and in 1942 joined the Pomona-Westco Division of Joshua Hendy Iron Works. His first assignment was in the Chicago District office and shortly thereafter he was transferred to the Westco Division at St. Louis as assistant to the sales manager.

In 1944 Fairbanks, Morse & Co., purchased the Pomona-Westco Division and Lemke was moved to Chicago as assistant to the manager of the Pump Division, the position he resigned in April this year.

North Carolina Drillers Organize At Recent Meet

REPRESENTATIVE water well drilling contractors of North Carolina met may 24, 8:00 p.m., at the Robert E. Lee Hotel in Winston-Salem, N. C., to formulate plans in organizing a state water well drillers' association.

The large number of men in attendance at this meeting was indicative of the interest among the operators in the advancement of the water well drilling industry in North Carolina. In all, 22 men were present, representing 15 companies now operating in the state. The meeting was also attended by five water well equipment factory representatives.

After an hour of open discussion on the benefits to be gained through an association, officers were elected to serve until the next scheduled meeting of the body which is to be held in the Fall. Officers selected were: R. O. Heater, Raleigh, President; L. L. Martin, Hickory, Vice-president; C. M. Hudson, Durham, Secretary & Treasurer.

The following men were elected as directors to serve with the officers in drawing up a constitution and by-laws which will be presented for the acceptance of the members at the next meeting: W. A. Holder, Clement; R. E. Faw, Hickory; E. D. Blake, Wilmington; R. W. Clayton, Winston-Salem; Herbert Heath, Penrose; and W. A. Kirkley, Charlotte.

The officers elected are to serve a

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temporary term after which at the end of six months and another meeting is held, permanent officials will be elected. Present at the meeting were two contractors from Virginia who operate their equipment in North Carolina. It was decided at this meeting that contractors in their position would be permitted to belong to the North Carolina association as associate members. As such, they will have no vote in the organization, but will have an opportunity to voice their opinion in forming the policy of the organization.

Water Tables Fall In New England

WATER levels in Central New England were observed to have dropped during the month of April and at the end of the month were substantially below normal for the season according to the U. S. Geological Survey.

Because of the lack of recharge during the month, ground-water levels in Pennsylvania were reported lower than they had been since the year of 1932. Connecticut water levels were also observed to be substantially lower than normally.

In the Everglades of Florida drought conditions are developing as the water levels are reported to have declined considerably, and the demand for irrigation in some areas exceeded by far available storage which resulted in the extreme drawdown of water levels.

The Ontario region also reported low water levels and stream flow and prospects for a normal runoff are contingent on receiving more than the normal amount of rainfall. The deficient stream flow observed in the Northeast States and southern Ontario was due mainly to the early thaw in March and below normal precipitation during April.

"Jet Rigger" . . .

(Continued from page 9)

Drilling in Utah is subject to strict state supervision. Permits for each well to be drilled, cleaned, repaired or deepened must be obtained from the state engineer before the work is started, giving date when it is expected to start.

No well can be drilled, repaired or deepened until the owner of the well receives authorization in writing from the state engineer.

Wells drilled through or into artesian aquifers or through material which will cave must be cased with sound casing material, which prior to being used, has been inspected and approved by the state engineer. In such wells the driven casing must not be enlarged or perforated or opened through the water confining beds.

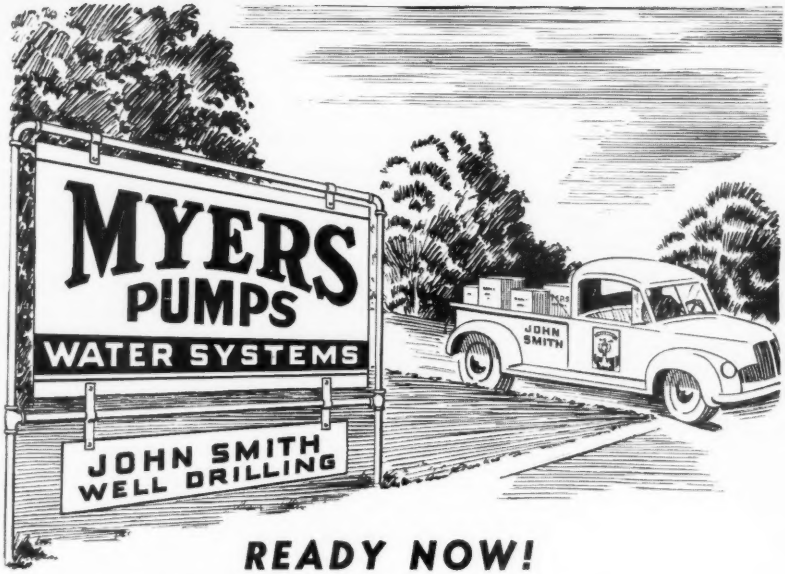
Utah Has Log Law

Perforations in a well casing are limited to one water bearing stratum except in underground basins where the water is known to be non-artesian and is so declared by the state engineer.

Utah has a log law which requires the driller to log each well for material in each ten-foot vertical interval; depth from ground to upper and lower limits of each waterbearing stratum; static level and temperature and yield in second-feet or gallons per minute of each completed well; and if the well is equipped with a pump and the drawdown at the measured yield.

All these measures are, of course, in the interests of conserving water and while they sometimes handicap the work of the driller, they are nevertheless followed to the letter.

Larson said that the pressure has been steadily dropping on the artesian wells and that thirty years ago it



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was much higher. "At the present time," he said, "there are state restrictions or priorities on the flowing water at the 140 and 420-ft. levels."

Water has been the key to unlocking the secrets of the desert. Water has made it bloom like the rose. The oldest irrigation project in the world was started in this then barren valley by the pioneer Mormons who used wooden flumes to transport the water, some of which are still in existence.

Since water is the product of the driller, he has played no small part in the development of the valley into one of the richest agricultural areas in the world.

Development . . . .

(Continued from page 7)

when mixed in concentrations of 5 to 15 per cent with air.

A word of caution regarding gravel pack wells. Unless the gravel pack is specifically silica, it may be composed of as much as 30 to 50 per cent dolomite. Acid treatment will then dissolve a large fraction of the gravel pack and the subsequent loss in volume may result in bridging around the screen, thus permitting fine sand to fall into the gap in the gravel pack. If the well construction permits, the possible adverse effects of bridging can be overcome by flushing the top of the gravel pack with water and tamping during the period of acid treatment.

One case is on record where a well with a porous concrete screen was acidized very effectively. In this case, sufficient acid was added in the well to form a concentration of two to three per cent within the well and was pumped out 15 minutes after addition. The specific capacity of this well was increased from 3.3 to 78.5 gpm. per foot of drawdown. The specific capacity when this well was new was 100 gpm. per foot of drawdown.

In the acid treatment of "limestone" (dolomite) wells, the more important effect of acidizing is to enlarge such thin crevices as provide channels for movement of water to the well and to open up new channels to other crevice systems. Naturally, larger crevices and more extensive crevice systems permit a greater yield from a well. If acid can be kept moving through small crevices a double purpose is served. First, the acid dissolves the soluble material increasing the cross-sectional area of the crevice, and second, movement tends to keep in suspension insoluble material loosened by the action of acid on the soluble material. It is desirable to prevent the settling or deposition and accumulation of insoluble clay and silt in the crevices.

Acid Often a Gamble

Acid treatment is often largely a gamble in rehabilitating limestone wells but if properly conducted there is no record of permanent damage being done to a well. Best results have generally been obtained by using a combination of methods to force the acid out into the formation. The methods used for this purpose for both limestone and sand and gravel wells are (1) addition of flush water, (2) surging with pump or a surge block, (3) development and retention of pressure within the well by sealing the top. Best results have been obtained by the combination of methods (1) and (3). When pressure development is used, the treatment may be controlled by use of a pressure gauge and a valve-equipped gas release line, both tapped into the well casing.

It is not at all unusual in drift or limestone wells to use three or four successive treatments with surging

and with complete removal of waste treatment products after each stage of treatment.

In any acid treatment, the spent acid and accumulative products should be pumped out until some time after the taste of acid or salt is no longer present. A minimum of 24 hours pumping is suggested after the taste test indicates no odd flavor. Chemical analysis at one well showed that it took three days continuous pumping at 600 gpm. to remove all of the reaction products. Intermittent surging to re-develop the well during this period is desirable.

Chlorine Is Effective

The results are not always immediately apparent. In one "limestone" well it was reported that the specific capacity (gpm. per foot of drawdown) was increased by acidizing from one before treatment to two a few days later. Eight months later it was reported that the specific capacity had gradually increased to 9.6.

In wells where bacterial growths have accumulated and effectively blocked the entrance of water, the addition of chlorine has been found to be effective. In one case, chlorine gas was used to form a solution of about 1/10 per cent concentration and added over a 24-hour period through a one-inch pipe to the well screen. This was a gravel-pack well, of 24-inch screen diameter, 36-inch O.D. gravel wall and 160 feet deep. Forty pounds of chlorine were added throughout the 24-hour period with occasional surging of the well by means of starting and stopping the pump.

Sandstones Acidized

Chlorinated lime, effective as a sterilizing agent, would not be expected to be as effective for chemical treatment of the well or pump as chlorine gas since it is an alkaline

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compound and tends to cause the deposition of lime rather than to dissolve it. Chlorine gas when dissolved in water is acidic and would tend to dissolve lime or iron deposits as well as to sterilize and destroy bacterial growths.

Sandstones have been acidized effectively in the oil fields, but few cases are on record for water wells. The history and number of these cases are not sufficient to warrant comment.

Calgon Has Been Used

Several modifications of chemical treatment are available. The use of solid carbon dioxide (dry ice) with chlorine has been successful. The purpose of the dry ice is to promote agitation and to create pressure to force the active chlorine back into the formation without diluting the chlorine concentration.

Copper sulfate has been used with chlorine to assist in killing biological growths. Data is not available on the effectiveness when used in wells.

Calgon has been used with chlorine, but it is slow acting and would not be effective in dissolving oxidized iron.

Wells Treated Annually

An industry in East St. Louis has reported that average loss in capacity of their 500 gpm. wells has been altered from two per cent per month to one-half to one per cent per month by treating annually for ten days. The wells are 110 to 130 feet deep in sand and gravel and constructed with 30-foot I.D. porous concrete screens. The well is treated on five consecutive days with individual treatments of 20 pounds of Calgon, two pounds of soda ash and five pounds of Santobright; then surged three times and flushed. After wating one or two days five additional treatments are applied.

In order to dissolve silica deposits, potassium fluoride has been used with hydrochloric acid. The resultant hydrofluoric acid is an effective solvent for silica. Theoretically such treatment may be effective in dissolving fine sand. The greater surface per unit weight of fine sand should make it dissolve at a greater rate than the larger grains. This of course involves the use of a highly toxic and dangerous chemical. Chemical tests are required to be certain that it has all been removed from the well.

There are altogether too few cases where complete data are available on the hydraulic characteristics of the pump and well before and after treatment. A satisfactory amount of such data on both successful and unsuccessful jobs of chemical treatment will serve to improve and promote this method of rehabilitation. There are too many records of wells that were treated unsuccessfully which should not have been treated at all or should have been treated in a different manner.

Question of Treatment

There is also a question concerning the frequency of treatment. In some localities it has been found worthwhile to set up a program of chemical rehabilitation every other year in order that the wells do not get in such poor condition that drastic treatment must be resorted to in order to gamble on obtaining satisfactory results.

This discussion has been purposely generalized. With such wide variety of sources of well waters and reasons for well failures, it is not desirable to include specific reagents or methods of use of such reagents.

The Illinois State Water Survey has records of acid treatment dating back to 1914. This Survey will be glad to assist in conducting necessary tests to help determine the ad-

visability of chemical treatment for wells in Illinois, and to determine the effectiveness of the treatment. The State Geological Survey will be glad to offer information on the character of the formation proposed for treatment. Both Surveys in Urbana are interested in chemical methods of rehabilitation and may be used to serve as a clearing-house for available information on chemical treatment.

Water Purifier

A 50-PAGE book of instruction on the uses of Perchloron, a product to be used in water purification, sewage disposal and as a bactericide in the food industry, has been issued by the Pennsylvania Salt Manufacturing Company according to their new bulletin.

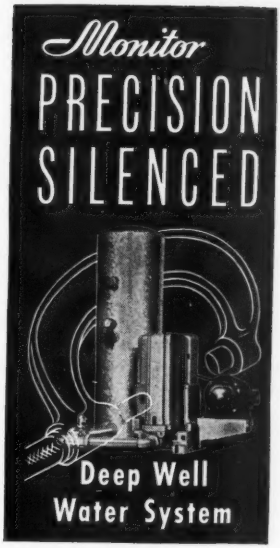
Following a description of the product, which is 70 per cent available chlorine, the book gives instructions on methods of preparation and application. Persons interested may secure the book free of charge by writing the company at 1000 Widener Bldg., Philadelphia 7, Pa.

Dealer Displays

THE F. E. Myers & Bro. Co. announces their new store planning program that offers ready-built and easy-to-build displays as well as many types of effective metal signs for both indoor and outdoor use by dealers in water systems.

Included in this program, which has been in preparation for nearly two years according to the news release, are floor and wall type fixtures conforming to the latest improvements in store interiors and adapted to the special requirements of the dealers.

A well-illustrated folder showing the use of various display equipment and containing specifications and prices is available.



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WIT BITS

Father: "Why were you kept in at school?"

Son: "I didn't know where the Azores were."

Father: "Well, in the future just remember where you put things."

Driller: "How about some old-fashioned loving?"

Girl: "Okay, I'll call grandma."

The hostess at a large gathering, rather proud of her voice, sang, "Carry Me Back to Old Virginia" in a rich soprano. As she finished the song she was touched to notice a distinguished - looking white - haired man bow his head and weep quietly. She made her way to him and said, "Pardon me, sir, but are you a Virginian?"

"No, madam," replied the elderly man brushing away a tear, "I am a musician."

Cowboy: "Getting your saddle on backward, aren't you?"

Dude Rancher: "That's all you know about it, smarty. You don't even know which way I'm going."

The wife of a small farmer was accustomed to selling her surplus butter to the town grocer. On one occasion the grocer said, "Your butter was underweight when I weighed it last week."

"Fancy that," replied the farmer's wife. "I mislaid my pound weight and used the pound of sugar you sold me instead."

Skunk: A pussy cat with a secret weapon.

The twins had been brought to be christened.

"What names?" asked the Clergyman.

"Steak and Kidney," the nervous father answered.

"Bill, you fool," cried the mother, "it's Kate and Sidney."

He gazed admiringly at the beautiful dress of the leading chorine.

"Who made her dress?" he asked his companion.

"I'm not sure, but I think it was the police."

Aunt: "Willie, why don't you stay away from those bad boys and play with the good ones?"

Willie: "Their mothers won't let me."

"Grandma, what kind of a husband would you advise me to get?"

"My advice is to leave the husbands alone and get yourself a single man."

Patrolman: "Yer honner, I just grabbed this guy taking apples off a peddler's cart."

Judge: "Hmm! Impersonating an officer. Ten days!"

"I'm sick of marriage. Tom hasn't kissed me since I came back from my honeymoon."

"Why not divorce him?"

"Huh? Oh, I'm not married to Tom."

She: "Has your father always been a driller?"

He: "No, he learned to swear like that in the Navy."

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DRILLS FOR SALE

71 Speed Star drilling machine in A-1 condition. Trailer mounted, with cables and tools. Jasper Newlin, Newton, Ill.

Bucyrus-Erie 24-W drill with type "E" semi-trailer mounting complete with 4", 6" and 8" drilling and fishing tools. Excellent condition. Box 129

Spudder, all steel, mounted on truck—with all tools. Capacity 600 ft. Price $2,000 cash. A. W. Crispen, 825 Frederica St., Owensboro, Ky.

1-Cyclone Model C drill mounted on 1936 1½ ton International truck, equipped with Ford model A engine, wooden frame and derrick. New string of tools included for 4" well. Price $1600. John Moody, 415 8th Street, Ann Arbor, Mich.

Well rig, well drilling and pump business, situated in Southwestern Iowa. P. O. box 96, Underwood, Iowa.

MISC. FOR SALE

New couplings for sale: 6" drive pipe, 5½", 7" and 8⅝" casing and 8" line pipe; liberal discounts. Crescent Pipe & Supply Co., Allegan, Mich.

MISC. FOR SALE

DART BAILER—10" x 10', NEW, cost $140, sell $75. Also—86, 8", 25 lb., recessed drive couplings, ¾" thread. Stewart Bros., Schenectady, N. Y.

DEEP WELL PLUNGER PUMP—18 in. stroke, American self oiling, gears enclosed, with 8 in. OD drop cylinder, plunger and rods, $250. Hamilton Mfg. & Machine Co., Hamilton, Mich.

WANTED

WANTED — Experienced driller, also modern portable cable tool rig capable of drilling 14 in. water wells to a depth of 400 ft. in gravel and clay. Will consider purchase of rig or will sub-contract. Would be interested in rig or driller separately. Work for at least one year in northern Mexico. Excellent and healthful working conditions. Please give full information. Manning & Granberry, DeRidder, La.

Bucyrus-Erie 22W, or 33W, or similar type and size machine. State condition of machine, and whether mounted or not mounted on truck. Box 128

Want to buy Armstrong 50, good condition. Also Keystone 5½, regardless of condition. Would prefer purchase in Middlewest or West. Box 130

WANTED

Small, light water well drill capable of handling 250' to 300' work. C. M. Terrill, Cody, Nebraska.

HELP WANTED

Two drillers wanted to operate modern machines on large drift holes and deep lime holes in and around Detroit. Vast experience unnecessary. $1.50 per hr. or contract on holes. Write, state age. Michigan Well Drilling Co., 8 E. Court, Pleasant Ridge, Michigan.

Driller wanted. Steady work, good wages. Modern equipment. Box 121

Experienced cable tool driller. One who can handle a drilling job to 12". Steady work, good wages. Box 123

Helper wanted, for drilling and pump work. G. I. training arrangements can be made. Box 122

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Experienced driller (cable tool) would like permanent position. Will accept foreign country job if family can go. Can furnish good references. Box 124

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